



GE Infrastructure
Water & Process Technologies

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April 16, 2008

INTERMOUNTAIN POWER SERVICE CORPORATION

850 W. Brush Wellman Road
Delta, Utah 84624-9546

Attention: Mr. Jerry Hintze

RE: Evaluate Costs: SCU operation with Soda Ash and affect on acid costs

Dear Jerry,

As we began the process of evaluation, we discovered pricing dynamics existed for acid and for soda ash, acid costing \$220/ton and soda ash costing \$245/ton. Also, the February 2008 TAP Water Analysis for the plant had an interesting dynamic, a higher carbonate and non-carbonate Hardness (greater demand for lime and soda ash).

Executive Summary

In the three Cases evaluated, the use of soda ash actually increased annual operating costs by \$334,200 to \$455,572, which represents an increase of 73% to 100%. Inflation has affected acid costs as well as soda ash costs. The only scenario we studied that resulted in savings was to increase cycles of concentration and increase Circ Water pH. The annual savings that could be realized range from \$35,757 to \$37,311. This would require using less Circ Water blowdown as makeup to the Scrubbers and using some other supplemental water source for Scrubber makeup, such as Settling Basin Water, Ash Water, or SCU Water.

It was well worth the effort to look at the economics of using soda ash in the SCU's, however with the current price of soda ash, **no savings are realized**. In fact, costs would dramatically increase with the use of soda ash.

Even Mother-Nature can be inflationary

The current water quality has a greater demand for soda ash (77.4%) and a greater demand for lime (11.5%) than the 5-sample median. However, for our projections of this report, we used the 5-sample median, since it represents 5-months of samples, rather than one-month.

Non-Carbonate Hardness = (M-H) = (M-Alkalinity - Total Hardness)

5-sample median =	(235ppm - 367ppm)	= 132 ppm	
Feb 2008 TAP Analysis =	(262ppm - 476ppm)	= 214 ppm	77.4% increase

Also...

Carbonate Hardness

5-sample median =	235ppm	
Feb 2008 TAP Analysis =	262ppm	11.5% increase

Regards,

Norm Hess
GE Water & Process Technologies



Three-Cases Studied

We will first look at the status quo, then changes in Circ Water cycles of concentration and pH. Finally, we will look at the use of soda ash.

At this time we will examine each in detail.

Case #1 -

- a) No change to SCU Operation
- b) Change Circ Water pH Control
- c) Operate at average cycles of concentration - 6.6 cycles

H2SO4 - \$220/ton & Na2CO3 - \$245/ton										COST						
pH	LSI	cycles	BD-gpm	MM#/d	MU-gpm	P-Alk	M-Alk	Ca	SiO2	BL5306 ppm	Na2(CO3) ton/day	H2SO4 ton/day	Na2(CO3) \$/day	H2SO4 \$/day	BL5306 \$/day	per year 350 d/yr
7.1	0.18	6.5	1,855	22.28	12,055	0	44	1151	39.0	4.0	0	5.25	\$0	\$1,155	\$142	\$453,840
7.6	0.94	6.5	1,855	22.28	12,055	0	82	1151	39.0	9.0	0	4.80	\$0	\$1,056	\$319	\$481,178
SAVINGS													\$0	\$99	-\$177	(\$27,338)

Case #2 -

- a) No change to SCU operation
- b) Change Circ Water pH control
- c) Change in Circ Water cycles of concentration - 6.5 cycles to 15 cycles

H2SO4 - \$220/ton & Na2CO3 - \$245/ton										BL5306					COST	
pH	LSI	cycles	BD-gpm	MM#/d	MU-gpm	P-Alk	M-Alk	Ca	SiO2	ppm	Na2(CO3) ton/day	H2SO4 ton/day	Na2(CO3) \$/day	H2SO4 \$/day	BL5306 \$/day	per year
7.1	0.18	6.5	1,855	22.28	12,055	0	44	1151	39.0	4.0	0	5.25	\$0	\$1,155	\$142	\$453,840
7.1	0.51	15	729	8.75	10,929	0	44	2655	101.0	6.0	0	5.05	\$0	\$1,111	\$84	\$418,083
7.6	1.27	15	729	8.75	10,929	0	82	2124	80.0	9.0	0	4.84	\$0	\$1,065	\$125	\$416,529
Savings: 15cyc-7.1pH													\$0	\$44	\$58	\$35,757
Savings: 15cyc-7.6pH													\$0	\$90	\$16	\$37,311

Case #3 -

- a) Change to SCU operation - use Na2(CO3) -- (M-H)=132
- b) Change Circ Water pH control
- c) Change in Circ Water cycles of concentration

H2SO4 - \$220/ton & Na2CO3 - \$245/ton										BL5306	Na2(CO3)	H2SO4	Na2(CO3)	H2SO4	BL5306	COST	
pH	LSI	cycles	BD-gpm	MM#/d	MU-gpm	P-Alk	M-Alk	Hard	SiO2	ppm	ton/day	ton/day	\$/day	\$/day	\$/day	per year	
7.1	0.18	6.5								4.0	0	5.25	\$0	\$1,155	\$142	\$453,840	
Status Quo - current operating costs - BASES																	
7.1	0.18	6.5	1,855	22.28	12,055	0	54	66	4.0	4.0	9.56	0.53	\$2,341	\$116	\$142	\$909,412	
7.6	0.94	6.5	1,855	22.28	12,055	0	108	66	4.0	4.0	9.56	0.10	\$2,341	\$22	\$142	\$876,803	
7.1	-1.03	15	729	8.75	10,929	0	54	150	6.0	4.0	8.66	0.73	\$2,122	\$95	\$56	\$795,643	
7.6	-0.27	15	729	8.75	10,929	0	108	150	6.0	4.0	8.66	0.56	\$2,122	\$74	\$56	\$788,040	
Savings: 6.5cyc-7.1pH													(\$2,341)	\$1,039	\$0	(\$455,572)	
Savings: 6.5cyc-7.6pH													(\$2,341)	\$1,133	\$0	(\$422,962)	
Savings: 15cyc-7.1pH													(\$2,122)	\$1,060	\$86	(\$341,803)	
Savings: 15cyc-7.6pH													(\$2,122)	\$1,081	\$86	(\$334,200)	



Cycle-up Analysis without soda ash to SCU's

Enter values into the shaded boxes.										Enter Customer Name, Location and Account Number Over Labels.									
GE Betz TOWER WATER CYCLING ANALYSIS VERSION 7.8 117 °F (Hottest Skin) 105 °F (Hottest Bulk Water) 0.7 M-ALK FACTOR										IPSC Delta, Utah 1-43749 MU-SCU w/o soda ash 4/16/2008									
VOL ##### (gal) RR 800,000 (gpm) D T 17 (deg F) EVAP 10,200 (gpm) F 0.75																			
CYCLES	pH	M-ALK (ppm as CaCO3)	Ca (ppm as CaCO3)	Mg (ppm as CaCO3)	SiO2 (ppm as SiO2)	COND (mmhos)	CI (ppm as Cl)	SO4 (ppm as SO4)	LSI CaCO3 Index	MgSi ***** = Exceeds ok = Under Sat	CMSi	RT75 (Retention Time in days)	B.D. (gpm)	M.U. (gpm)					
MAKEUP	10.20	122	177	131	7	1260	237	205	*****										
1.5	7.90	119	266	197	10	1890	356	308	0.81	ok	ok	0.48	20,400	####					
2.0	8.13	159	354	262	13	2520	474	410	1.27	ok	ok	0.96	10,200	####					
2.5	8.31	198	443	328	17	3150	593	513	1.63	ok	ok	1.44	6,800	####					
3.0	8.45	238	531	393	20	3780	711	615	1.92	ok	ok	1.93	5,100	####					
3.5	8.58	278	620	459	23	4410	830	718	2.17	ok	ok	2.41	4,080	####					
4.0	8.68	317	708	524	27	5040	948	820	2.38	ok	ok	2.89	3,400	####					
4.5	8.78	357	797	590	30	5670	1067	923	2.57	ok	ok	3.37	2,914	####					
5.0	8.86	397	885	655	34	6300	1185	1025	2.74	ok	*****	3.85	2,550	####					
5.5	8.94	436	974	721	37	6930	1304	1128	*****	ok	*****	4.33	2,267	####					
6.0	9.01	476	1062	786	40	7560	1422	1230	*****	ok	*****	4.81	2,040	####					
6.5	9.07	515	1151	852	44	8190	1541	1333	*****	*****	*****	5.29	1,855	####					
7.0	9.13	555	1239	917	47	8820	1659	1435	*****	*****	*****	5.78	1,700	####					
7.5	9.18	595	1328	983	50	9450	1778	1538	*****	*****	*****	6.26	1,569	####					
8.0	9.24	634	1416	1048	54	10080	1896	1640	*****	*****	*****	6.74	1,457	####					
8.5	9.28	674	1505	1114	57	10710	2015	1743	*****	*****	*****	7.22	1,360	####					
9.0	9.33	714	1593	1179	60	11340	2133	1845	*****	*****	*****	7.70	1,275	####					
12.0	9.56	952	2124	1572	80	15120	2844	2460	*****	*****	*****	10.59	927	####					
15.0	9.74	1190	2655	1965	101	18900	3555	3075	*****	*****	*****	13.48	729	####					

WITH pH CONTROL: 7.10 44 M-ALK										WITH pH CONTROL: 7.60 82 M-ALK									
ACID ACID										ACID ACID									
CYCLES	(ppm)	#/day	Ca	COND	SO4	LSI	MgSi	CMSi		CYCLES	(ppm)	#/day	LSI	MgSi	CMSi				
1.5	75	18401	266	1890	376	-0.40	ok	ok		37	9081	0.36	ok	ok					
2.0	115	14054	354	2520	515	-0.28	ok	ok		77	9394	0.47	ok	ok					
2.5	154	12605	443	3150	654	-0.19	ok	ok		116	9498	0.56	ok	ok					
3.0	194	11880	531	3780	792	-0.12	ok	ok		156	9550	0.63	ok	ok					
3.5	234	11445	620	4410	931	-0.06	ok	ok		196	9581	0.69	ok	ok					
4.0	273	11155	708	5040	1070	-0.01	ok	ok		235	9602	0.75	ok	ok					
4.5	313	10948	797	5670	1208	0.04	ok	ok		275	9617	0.79	ok	ok					
5.0	353	10793	885	6300	1347	0.08	ok	ok		315	9628	0.83	ok	ok					
5.5	392	10672	974	6930	1486	0.12	ok	ok		354	9637	0.87	ok	ok					
6.0	432	10576	1062	7560	1624	0.15	ok	ok		394	9644	0.91	ok	ok					
6.5	472	10497	1151	8190	1763	0.18	ok	ok		434	9649	0.94	ok	ok					
7.0	511	10431	1239	8820	1902	0.21	ok	ok		473	9654	0.97	ok	ok					
7.5	551	10375	1328	9450	2041	0.24	ok	ok		513	9658	0.99	ok	ok					
8.0	591	10327	1416	10080	2179	0.26	ok	ok		553	9662	1.02	ok	ok					
8.5	630	10286	1505	10710	2318	0.29	ok	ok		592	9665	1.04	ok	ok					
9.0	670	10250	1593	11340	2457	0.31	ok	ok		632	9667	1.07	ok	ok					
12.0	908	10102	2124	15120	3289	0.42	ok	ok		870	9678	1.18	*****	ok					
15.0	1146	10017	2655	18900	4121	0.51	ok	ok		1108	9684	1.27	*****	ok					

Vol = 10,200,000 gal

MU = 12,055 gpm

MU = 10,929 gpm



Cycle-up Analysis with soda ash to SCU's

<div><div></div><div>GE Betz</div></div> <div>TOWER WATER CYCLING ANALYSIS VERSION 7.8</div> <div>117 °F (Hottest Skin) 105 °F (Hottest Bulk Water)</div> <div>0.7 M-ALK FACTOR</div>							<div>IPSC</div> <div>Delta, Utah</div> <div>1-43749</div> <div>MU-SCU w/ soda ash</div> <div>4/16/2008</div>				<div>VOL ##### (gal)</div> <div>RR 800,000 (gpm)</div> <div>D T 17 (deg F)</div> <div>EVAP 10,200 (gpm)</div> <div>F 0.75</div>			
CYCLES	pH	M-ALK (ppm as CaCO3)	Ca (ppm as CaCO3)	Mg (ppm as CaCO3)	SiO2 (ppm as SiO2)	COND (mmhos)	Cl (ppm as Cl)	SO4 (ppm as SO4)	LSI CaCO3 Index	MgSi ***** = Exceeds ok = Under Sat	CMSi	RT75 (Retention Time in days)	B.D. (gpm)	M.U. (gpm)
MAKEUP	10.20	20	5	5	5	950	237	205	0.69					
1.5	6.51	21	8	8	8	1425	356	308	-2.82	ok	ok	0.48	20,400	####
2.0	6.74	28	10	10	10	1900	474	410	-2.36	ok	ok	0.96	10,200	####
2.5	6.92	35	13	13	13	2375	593	513	-2.00	ok	ok	1.44	6,800	####
3.0	7.07	42	15	15	15	2850	711	615	-1.71	ok	ok	1.93	5,100	####
3.5	7.19	49	18	18	18	3325	830	718	-1.46	ok	ok	2.41	4,080	####
4.0	7.30	56	20	20	20	3800	948	820	-1.25	ok	ok	2.89	3,400	####
4.5	7.39	63	23	23	23	4275	1067	923	-1.06	ok	ok	3.37	2,914	####
5.0	7.47	70	25	25	25	4750	1185	1025	-0.89	ok	ok	3.85	2,550	####
5.5	7.55	77	28	28	28	5225	1304	1128	-0.74	ok	ok	4.33	2,267	####
6.0	7.62	84	30	30	30	5700	1422	1230	-0.60	ok	ok	4.81	2,040	####
6.5	7.68	91	33	33	33	6175	1541	1333	-0.47	ok	ok	5.29	1,855	####
7.0	7.74	98	35	35	35	6650	1659	1435	-0.35	ok	ok	5.78	1,700	####
7.5	7.80	105	38	38	38	7125	1778	1538	-0.24	ok	ok	6.26	1,569	####
8.0	7.85	112	40	40	40	7600	1896	1640	-0.14	ok	ok	6.74	1,457	####
8.5	7.90	119	43	43	43	8075	2015	1743	-0.04	ok	ok	7.22	1,360	####
9.0	7.94	126	45	45	45	8550	2133	1845	0.05	ok	ok	7.70	1,275	####
12.0	8.17	168	60	60	60	11400	2844	2460	0.51	ok	ok	10.59	927	####
15.0	8.35	210	75	75	75	14250	3555	3075	0.87	ok	ok	13.48	729	####

WITH pH CONTROL: 7.10 44 M-ALK							WITH pH CONTROL: 7.60 82 M-ALK						
CYCLES	ACID (ppm)	ACID #/day	Ca	COND	SO4	LSI	MgSi	CMSi	ACID (ppm)	ACID #/day	LSI	MgSi	CMSi
1.5	0	0	8	1425	308	-1.93	ok	ok	0	0	-1.18	ok	ok
2.0	0	0	10	1900	410	-1.82	ok	ok	0	0	-1.06	ok	ok
2.5	0	0	13	2375	513	-1.73	ok	ok	0	0	-0.98	ok	ok
3.0	0	0	15	2850	615	-1.66	ok	ok	0	0	-0.90	ok	ok
3.5	5	255	18	3325	722	-1.60	ok	ok	0	0	-0.84	ok	ok
4.0	12	498	20	3800	831	-1.55	ok	ok	0	0	-0.79	ok	ok
4.5	19	672	23	4275	940	-1.50	ok	ok	0	0	-0.74	ok	ok
5.0	26	802	25	4750	1049	-1.46	ok	ok	0	0	-0.70	ok	ok
5.5	33	904	28	5225	1158	-1.42	ok	ok	0	0	-0.67	ok	ok
6.0	40	985	30	5700	1267	-1.39	ok	ok	2	53	-0.63	ok	ok
6.5	47	1051	33	6175	1376	-1.36	ok	ok	9	204	-0.60	ok	ok
7.0	54	1106	35	6650	1484	-1.33	ok	ok	16	329	-0.57	ok	ok
7.5	61	1153	38	7125	1593	-1.30	ok	ok	23	436	-0.54	ok	ok
8.0	68	1193	40	7600	1702	-1.27	ok	ok	30	527	-0.52	ok	ok
8.5	75	1228	43	8075	1811	-1.25	ok	ok	37	606	-0.49	ok	ok
9.0	82	1258	45	8550	1920	-1.23	ok	ok	44	675	-0.47	ok	ok
12.0	124	1382	60	11400	2573	-1.11	ok	ok	86	959	-0.36	ok	ok
15.0	166	1453	75	14250	3227	-1.03	ok	ok	128	1120	-0.27	ok	ok

Vol = 10,200,000 gal

MU = 12,055 gpm

MU = 10,929 gpm

GE Infrastructure Water & Process Technologies

Customer:	Intermountain Power Service Corporation	Date:	January 21, 2009
Address:	Delta, Utah	Cust. No.	1000043749
System:	SCU – Flocculant Study	Reported To:	Cindy Jones
		CC:	Don Smith Dean Wood Jerry Hintze

Dear Cindy,

Yesterday, I worked with two Lab Techs (Chris and Geno) and we evaluated flocculants for the SCU's. The product currently used in the SCU's at IPSC is PolyFloc AE1123. We examined this polymer and three other polymers.

PolyFloc AE1115 - Anionic, low charge density, high molecular weight, polymeric flocculant

PolyFloc AE1123 - Anionic, low charge density, high molecular weight, polymeric flocculant

PolyFloc AE1132 - Anionic, high charge density, high molecular weight, polymeric flocculant

PolyFloc AE1703 - Anionic, high charge density, 'super' high molecular weight, polymeric flocculant

The AE1703 is magnitudes larger than the molecular weight of the other polymers and would be considered a 'super' sized polymer. AE1115 is the smallest molecular weight of the products tested.

Preparation: We prepared the On Site Reservoir water for testing in a common container. We first added 25 ppm of Ferric Chloride and then raised the pH, using the lime slurry, to a pH of 10.5.

TESTS	pH	Ferric ppm	AE1115 ppm	AE1123 ppm	AE1132 ppm	AE1703 ppm	Comments
1 st Test	10.5	25	1.0	1.0	1.0	1.0	
Floc			1	3	2	4	
Clarity			1	3	2	4	
2 nd Test	10.5	25	2.0	2.0	2.0	2.0	
Floc			1	3	2	4	
Clarity			2	3	1	4	
					AE1703	AE1703	
3 rd Test	10.5	0			1.0	3.0	At pH of 10.5 and without ferric, performance was poor.
Floc					1	2	
Clarity					3	3	
					AE1703	AE1703	
4 th Test	10.8	0			1.0	3.0	We increased pH to 10.8, which increased MgOH & total available
Floc					4	4	floc. Operating without ferric is possible with slightly high pH.
Clarity					3	4	

Grading Performance: 4 (Best), 3 (Good), 2 (Fair), 1 (Poor)

Summary: There are a lot of dynamics in the operation of the SCUs, which are impossible to simulate in a beaker. This much we know, with the AE1703, we did see more floc, continuing formation of floc during the slow mix cycle, and greater clarity. Once the sludge bed is established in the SCU, with the proper pH (slightly higher), operation without ferric is a possibility. There was some concern expressed by the Lab Techs about the SCUs being more sensitive to operate in the winter, thus they preferred to conduct evaluations in the summer. We think either timeframe is acceptable. We recommend testing one semi bulk of PolyFloc AE1703. The cost of PolyFloc AE1703 is \$1.62/# or \$3,742.20 per semi bulk. The actual feed rate would be determined during the testing period. I am attaching a Product Fact Sheet for PolyFloc AE1703.

Regards,

Norman Hess
GE Water & Process Technologies

IP12_000581



GE Betz

A Division of GE Specialty Materials

June 24, 2002

INTERMOUNTAIN POWER SERVICE CORPORATION

850 W. Brush Wellman Road
Delta, Utah 84624-9546

Attention: Mr. Jerry Hintze
Mr. Dean Wood
cc: Mr. Jon Finlinson
Ms. Cindy Jones

RE: Sludge Thickener & Filter Performance

Update Current Conditions
Review Thickener Design
Filter Operation

Hi Jerry and Dean,

Recently, Rich Wallace and I reviewed the operation of the Sludge Thickener and Filter System. As part of our review, we looked at the mechanical setup, operating practices, and chemistry. The status of current slurry characteristics for the Sludge System includes high TDS, high levels of small particle fraction, and low-density Thickener solids. ***Everything done to date has not obtained the desired results of:***

- clear thickener overflow
- effective solids removal from the Thickener to the Filter Feed Tank
- consistent filter cake production.

The ***long-term solution appears*** to be installation of supplemental induced air capability, however solids are currently accumulating in the Settling Pond, and this problem is becoming increasingly problematic as the Settling Pond fills. The ***cost of doing nothing*** will be the removal and disposal of solids from the Settling Pond and it will be substantial. We would like to suggest a ***change of focus*** and attempt again to work with what we have to improve the current situation.

CHANGE OF FOCUS – Thus far, we have attempted to work ***with former operating practices that are no longer valid***. We want to target our future efforts differently.

Material Balance - Any solids entering the Thickeners must be removed as Thickener underflow, otherwise solids are lost to the Settling Pond by the Thickener overflow. Once the solids are in the Filter Feed Tank, the focus is then on the performance of the filters. Anything less than balancing the materials

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IP12_000582



being sent to the thickeners, will result in solids ending up in the Settling Pond.

Proposed Concept -

1) Mechanical

a) ***Thickener Still Wells –***

- i) Design all slurry/water streams to enter the Still Well *tangentially*
- ii) Add flocculent to the Still Well

b) ***Filters***

- i) Use the Filter Aid Makedown Tank
- ii) Add new polymer pumps

2) Operational

a) ***Remove solids*** from the Thickeners ***based on inventory, not density***

- i) Always remove solids to give clear overflow
- ii) Example: 30 min. to Filter Feed Tank, then 30 min. recycle
Adjust the pump time based on sludge bed inventory of 6 to 8 feet

b) ***Focus on Filter Performance*** – Conduct filter leaf testing

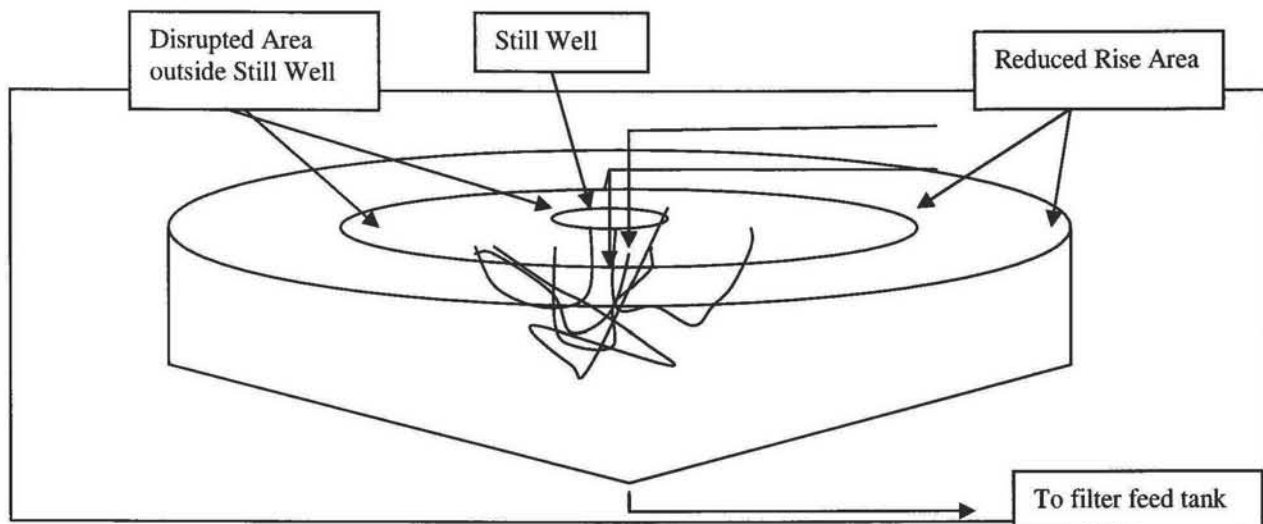
- i) Determine proper filter material sizing
- ii) Determine effective filter aid product and dosage

3) Chemistry – The Chemistry has been done. We know that AE1703 and CE2660 both produce a very substantial floc. We will re-test both products in the filter leaf device to further verify efficacy.



Mechanical –

- 1) **Thickener Slurry – need to feed tangentially** - The slurry is currently being added perpendicularly. This is disrupting the Still Well and the solids in the Thickeners. It is effectively increasing the size of the Still Well and *diminishing the size of the rise area*. This is having the negative effect of increasing the rise rate and aggravating solids carryover. We need to change the influent streams to enter tangentially, to improve settling.
- 2) **STILL WELL – FLOCCULANT FEED** – TO PROVIDE MAXIMUM AVAILABLE CHARGE FOR FLOCCULATION, THE POLYMER NEEDS TO BE FED TO THE STILL WELL (RETREAT RECIRC).



- 3) **Filters** – Because the solids characteristics have changed so dramatically, we need to depend more on the filters than ever before. We need to conduct *filter leaf testing* to determine the idea filter cloth pores size and the optimal filter aid feed rate.

Filter Aid (polymer) use becomes more important than in the past since we are working on filtering a less dense material. We need two things to be done prior to initiation of a test.

- a) **Initiate the use** the Filter Aid Makedown Tank (already in existence)
- b) **Buy two new polymer pumps** for the filter aid. The feed rate of the filter aid will be a high rate in order to agglomerate the low-density sludge. We recommend the following:

Part #1401047	Wilden Pump 0.2 to 4.5 gpm (288 to 6480gpd)	\$376.00
Part #1418981	Air Filter Regulator	\$ 83.00
Part #1409398	Calibrated Cylinder (1,000 ml)	\$ 50.00
Part #2012535	PVC Plumbing Assembly	<u>\$ 88.00</u>
TOTAL		\$597.00



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We suggest you buy two (2) of the Wilden Pumps, so that there would be redundancy.

Operational –

- 1) **Remove solids** from the Thickeners should be based on inventory, not density. Because of high TDS and small particle size, the sludge bed does not compress. Thus, based on current operating conditions, a 50% density is never obtained (the exception is when the Thickener is being used as a classifier – no polymer, only the largest particles are removed by underflow).

We recommend taking the solids from the Thickeners on a *timed bases*. For instance, pump solids to the Filter Feed Tank for 30 minutes from A Thickener and have B Thickener in recycle. After 30 minutes, switch the Thickeners. At 175 gpm, 252,000 gallons will be pumped to the Filter Feed Tank in a 24 hour period. The holding capacity of the Filter Feed Tank is 400,000 gallons. The 252,000 gallons could be processed in 6 to 12 hours. ***Actual pump time to the Filter Feed Tank would be modified based on solids inventory in the Thickener.*** We want to have 6 to 8 feet of solids inventory in the Thickeners.

- 2) **Focus on Filter Performance** – Upon your review and approval of our plan, we would conduct filter leaf testing on the Plant site using actual solids from the system. We would do this to determine the proper filter material sizing and effective filter aid product and dosage

Chemistry –

The polymer chemistry recently test in the Lab looks good. We know that AE1703 and CE2660 both produce a very substantial floc. We will re-test both products in the filter leaf device to further verify efficacy. I am ordering a filter leaf from Eimco and should be ready to go shortly.

Sincerely,

GE Betz

Norm Hess



GE Betz

A Division of GE Specialty Materials

July 31, 2002

INTERMOUNTAIN POWER SERVICE CORPORATION

850 W. Brush Wellman Road
Delta, Utah 84624-9546

Attention: Mr. Jerry Hintze
Mr. Dean Wood
cc: Ms. Cindy Jones

RE: July 23, 2002 Study - Sludge Thickener & Filter Performance

Hi Jerry and Dean,

On July 23, 2002, Rich Wallace and I conducted a Filter Leaf Study to determine if a change of focus might result in improved Thickener overflow and provide satisfactory Filter cake production. The Focus was on the Filter operation and ***whether a filter aid would allow lower density slurries to be dewatered and caked.*** Also, to consider operating the Thickeners in series, the first unit being operated as a Clarifier and the second as a Thickener.

Test Work and Observations – As of July 2002, the TDS (Total Dissolved Solids) of the Thickener Feed has increased to 66,000mMhos (about twice that of sea water), preventing flocculation and settling of the solids. ***Even at 5X normal feed of AE 1703 or CE2660, we were unable to get flocculation and settling.*** Also, as recently as February to May 2002, we have been able to visually identify approximately 25-30% classified solids (larger CaSO₄ particles), we now see <5% larger particle formation.

- **In February 2002**, Thickener Feed had a 27,500mMhos conductivity and a visual classification of **large particles of 25-30%.**
- **In July 2002**, the Thickener Feed had increased to 66,000mMhos conductivity and had a visual classification of ***larger particles of <5%.***

As has been determined, ***oxygen is less soluble in high TDS waters.***

This raises two very important questions.

- Are high TDS waters (in particular, Na conc.) the secondary or primary cause of inadequate oxidation of CaSO₄ in the Scrubbers?
- If the TDS of the Scrubber Water were lowered (say to less than 18,000mMhos), would adequate oxidation of the CaSO₄ occur to allow successful operation of the Sludge System?



Page 2

I have included water analysis from April 2001, August 2001, and September 2001. The Thickener Feed had a Sp. Cond. of 62,100mMHos last September. Thus, we seem to be seasonally cycling the TDS of the Scrubber waters and we haven't been below 18,000mMHos in the Scrubbers since prior to February 2001.

We would suggest the following work be down.

- **Conduct a test in the Scrubbers with lower TDS Waters** (Ash Water? Dilute the Recovered Water? Improve the performance of the SCU?).
- If lower TDS waters will facilitate adequate oxidation of CaSO₄ in the Scrubbers, focus on a **Plant-wide Water Balance**, and establish maximum operating parameters for the Scrubber System.
- **Lower the TDS levels of all waters in at IPSC.** We have done a preliminary review of the SCU's. We are confident we can improve SCU performance and lower the TDS levels to the plant.

It appears reasonable at this time, that the need at IPSC is lower TDS waters. Lower TDS waters, may eliminate the need for induced oxidation to the Scrubbers. A **plant-wide water balance** and management of water resources may provide the **lowest cost and greatest benefit to IPSC.**

This is our conclusion from work done last week at IPSC. We look forward to discussing it with you.

Sincerely,

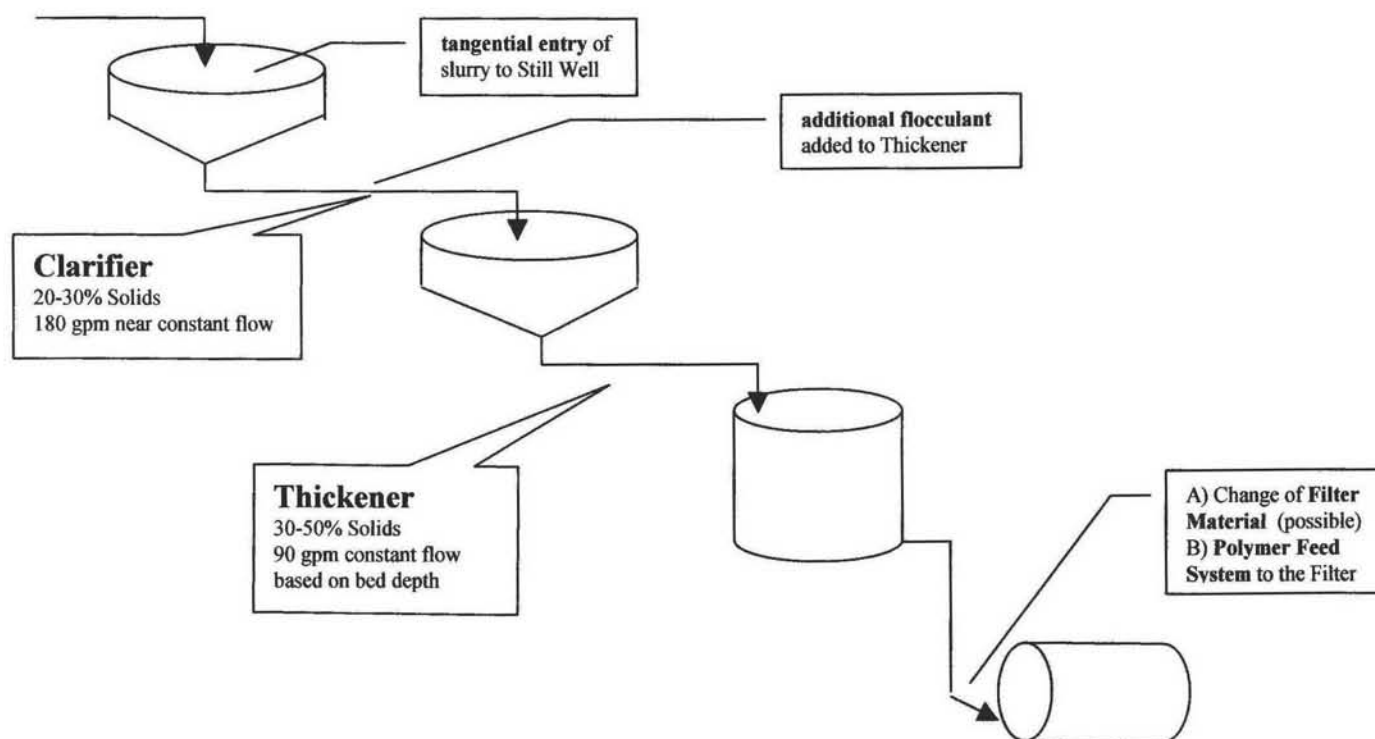
Norm Hess



Notes from Meeting with Dean Wood on July 23, 2002.

Possible Operating Sequence

Change of Focus – The following physical arrangement is our best chance to successfully operate the Sludge System. It would require some changes, including operating parameters, tangential entry of slurry to the Still Wells, additional flocculant added to the Thickener, possible change of Filter material determined by Filter Leaf tests, and a Polymer Feed System to the Filters.





GE Betz

A Division of GE Specialty Materials

Customer: **Intermountain Power Service Corp.**
Address: **Delta, Utah**
System: **Scrubber – Sludge System**

Date: **August 14, 2002**
Cust. No. **1000043749**
Reported To: **Dean Wood**
cc: **Jerry Hintze**
Cindy Jones
Richard Wallace

Hi Dean,

The following has been prepared to summarize our meeting, summarize work done to date, and to layout a game plan to complete our study.

Background – Beginning in February 2001, the Thickener Sludge became a problem to handle. It would not develop adequate density (50%) to dewater and cake. Consequently, solids carryover from the Thickeners began and has persisted ever since. Since February 2001, there have been extensive studies of the water, sludge characteristics, polymer chemistry for flocculation, polymer chemistry for filter cake aid, and degree of oxidation of the sludge. We all know a lot more now than we did in the beginning, i.e., incomplete oxidation of scrubber particles, small particle formation, and season/operation fluctuation of TDS.

Filter Leaf Test – On July 23rd, Rich Wallace and I attempted to conduct Filter Leaf Testing. We were unable to get the sludge to floc and to settle, even with 4x to 5x normal polymer feedrates. We tested Sp. Cond. of the Thickener Feed Slurry and found that it had increased since May from 36,000mMHos to 66,000mMHos (higher TDS than sea water). Also, we visually could see that the **large particle fraction had decreased** from 25-35% to <5%. It appears there is a correlation between high TDS (possibly Na) and CaSO₃/CaSO₄ particle formation. **Because we were not able to effect flocculation of the slurry, we were unable to conduct the Filter Leaf Testing.**

Question: Because of this observation of large particle fraction, the question is raised, is incomplete oxidation of Scrubber particles significantly impacted by high TDS/Na waters? And if so, would a reduction of TDS/Na in the Scrubber Water result in adequate oxidation to form the desired CaSO₄ particles without forced oxidation?

Consultation – Following our Filter Leaf effort, we did a broadcast VM to our PowerGen Group, looking for similar experiences and for experts that could assist. We have had conversations with a number of people with scrubber experience and have centered our efforts on two individuals, one being a GE Betz employee, Dr. Dave Pollizoti, and one being an associate we've worked closely with over several years, Mike Thompson, an employee of Big River Power. We may want to consider both these gentlemen as consultants in completion of the study.

IP12_000589

GAME PLAN – The following are the items discussed and have been requested by Dr. Pollizoti and Mike Thompson. Assignments have been made to develop and acquire this information and this is a summary of those assignments. We need the following:

- 1) **Coal History** – Dean is to coordinate efforts to trend Coal analytical history 12 months prior to 2/2001 and Coal History to-date. We are looking for information on: Fe, S, Na, K, and Mg
- 2) **Thickener Feed Solids Analysis** – Norm is coordinating efforts to have Thickener Feed Solids analyzed for: CaSO₃, CaSO₄ anhydrous, CaSO₄ hemi hydrate, and CaSO₄ gypsum.
- 3) **Current Water Analysis** – Dean is to provide us results of recent and past analysis of Plant Waters: River, SCU, Cooling Towers, Ash Water, Settling Basin, Recovered Water, and Thickener Feed.
- 4) **Hydraulic Balance** – It would be helpful to conduct a recent assessment of water sources and volumes; also, current Plant usage of different water sources.
- 5) **Single Module Test** – Dean, you mentioned the possibility of testing low TDS water in a single Scrubber Module. What is the timeframe for doing that?
- 6) **Consultants** – After we gather and compile the above data, we will then meet again, and decide whether we have enough encouraging data to warrant paying consulting time and whom we should involve.

Please let me know if I left anything out or should amend the GAME PLAN.

Best Regards,

Norm Hess



GE Betz

A Division of GE Specialty Materials

Customer: **IPSC**
Address: **Delta, Utah**
System: **Sludge – Thickeners**

Date: **September 26, 2002**
Cust. No. **1000043749**
Reported To: **Dean Wood**
Jerry Hintze

Notes: System Design Filter Leaf Work (9/26)

Dean and Jerry,
Here is as brief summary of Thickener Design and our work today.

Design: Thickener Diameter 60'
Center Well 8'
Approx. depth 12'
Area = $2,776 \text{ ft}^2 - 50 \text{ ft}^2 = 2,726 \text{ ft}^2$
System Flow rate 1,200 gpm
Rise Rate - Total Flow to the 1st Thickener = $1,200 \text{ gpm} / 2,726 \text{ ft}^2 = 0.43 \text{ gpm/ft}^2$
Rise Rate - 1st Thickener underflow to 2nd Thickener = $180 \text{ gpm} / 2,726 \text{ ft}^2 = 0.065 \text{ gpm/ft}^2$

Series Concept: Operate Thickeners in series, using the 1st Thickener as a clarifier, taking its underflow continuously to the 2nd Thickener. Then manage the sludge in the Thickeners based on level of sludge in the Thickeners. Thus, the flow from the 2nd Thickener to the Filter Feed Tank would not be controlled on density but rather sludge inventory in the Thickener. The criteria for sludge management would be sludge depth. Polyfloc AE1703 would be fed in three locations. The 1st Thickener would be receive 2 – 10ppm (based on current system conditions) and the 2nd Thickener would receive an additional 2-10ppm. The Filter would now need a separate feed system, which we can provide for the trial, and would have 10 – 20 ppm of AC1703 fed to it as a filter aid.

Needed Changes:

- 1) **System TDS** – Concentrations need to be reduced. The current Sp. Cond. is 65,000mMhos. The dilution we made for the filter leaf test was to 42,000mMhos. Ideally, this should be below 20,000mMhos, however a reduction even to 42,000mMhos made it possible to conduct the filter leaf test successfully. I suggest we target a minimum 50% reduction (32,500mMhos). This is critical parameter and needs to be controlled for future success.
- 2) **Still Well Design** – The current design receives solids perpendicularly rather than tangentially. This change still needs to occur to prevent disruption of the Thickener settling areas, resulting in carryover of the small particle sludge.
- 3) **AE1703 feed to 2nd Thickener** – Tubing or piping needs to be added to the Center Well.
- 4) **Filter Polymer Feed System** – We have a “Hydro Force” System we will provide for the evaluation.

This is a brief summary of the work to date. The emphasis is to determine whether clear water can be produced from the Thickeners and whether cake can be generated using the existing filter cloth. Based on the work of 9/26, it appears possible. The successful implementation could result in significant savings avoiding costly changes to the system and increased future operating costs.

Regards,

Norm Hess
Rich Wallace

IP12_000591



GE Betz

A Division of GE Specialty Materials

Customer: **IPSC**
Address: **Detla, Utah**
System: **Sludge**

Date: **July 3, 2003**
Cust. No. **1000043749**
Reported To: **Jerry Hintze**
Dean Wood
Cindy Jones

Thickener Sludge System

Hi Jerry, Dean, and Cindy,

1) **Last night I visited Sludge** and worked with Scott Robison and his crew. An interesting thing occurred in Sludge during the past couple of weeks. They were seeing a constant low density in the Thickener sludge, were not settling solids and not making good filter cake. This condition could possibly be associated with the thickener high recirc rates and high solids retention time. Because they saw no progress in improving the densities, they decided to shut off the polymer to the Thickeners. After the polymer was shut off for a short period of time, they saw an increase in density and the overflow cleared for several days.

As I have considered this, I have decided this could suggest that the Thickeners, through high rates of recirc and continued feed of poly, had accumulated 'excess charge density'. Meaning, the smaller sheared polymer components were actually repelling each other because all charge sites were populated with similar charges. That is the only thing that seems to make any sense to me. Similar charges would repel each other and reduce density; dissimilar charges attract. As new uncharged particles are then introduced to the thickener, they react with the highly charged particles, agglomeration occurs, settling occurs, densities increase, filter cake production improves, and the world becomes a better place to live.

2) **For at least the past 24-hours**, the C Thickener has had to feed directly to the Filter Feed Tank without recirc capability. They adjusted the underflow pump rate and successfully did it! The density did periodically increase during this time, however the overall density was lower than 50% - at times considerably lower than 50%. This was done while no AE1703 was being fed.

3) **Filter Cake Production** - Last night, when I arrived, the filter cake production (10:00pm) was about 18tph, probably because of the small particles, lower density materials in the Filter Feed Tank, and no polymer feed. I asked Bob and Scott if we could put the polymer feed system to the filters online and they agreed to do that. After the polymer feed line was cleared and we had good water flow through it, we initiated feed of PolyFloc AE1703 at 1.0 gph. This is where I think it put us as far as polymer feed.

Filter Flowrate	600gpm	=> 0.3MM#/hr	
AE1703	1.0gph	=> 9#/hr	=> 30ppm (to the filter)

Most of the work we did with the filter leaf testing in the lab was in the range of 20 to 30 ppm of PolyFloc AE1703, so this was in line with our test work. We were please to see an immediate increase in filter cake production from 18tph to a peak of 42tph. It settled into an operating range of 36 to 38 tph.

Of course, this is not great tonnage from a historical standpoint, however with the fines we were dealing with, it was a significant improvement. The filter cake was about 0.5" in thickness and was reasonably dry.

IP12_000592

4) **I talked with Ed Purcell this morning** and we agreed to start the feed of AE1703 back to the Thickeners. The AE1703 Filter Feed System is now available and we recommend using it. Ed suggested increasing the size of the pump on the Stranco Polymer Feeder to the Filters, in order to give some flexibility in feed rates as opposed to simply feeding a maximum of 1.0gph, which may or may not be adequate.

5) **There are a number of things that could be done to improve Thickener Operation.** Some of these are driven by the timing of getting additional air to the scrubbers and the hope of improving conditions with improved oxidation of Sulfur to Sulfate. Since, we are still a few months (six months) away from the additional air, I suggest a plan be developed. I think the best chance for this plan to work is if a Team crafts it. Not just Norm Hess from GE Betz or Dean Wood from IPSC Engineering, but maybe Norm, Dean, Scott, Scott, Ed, and Keith, or at least a couple of the Night Sups. I would make suggestions and the reasons why certain things need to be done, as we have done in the past, however we need to create a consensus. They Night Sups have considerable experience dealing with the frustrations of the system and may guide us away from previously unsuccessful attempts. We need to develop new operating parameters, an operations manual for operators that only work in Sludge 4 weeks a year, and formalize what will be done.

This is my suggestion, what do you think? I'll talk with you next week.

Have a great 4th of July.

Norm



GE Betz

A Division of GE Specialty Materials

Customer: **IPSC**
Address: **Detla, Utah**
System: **Sludge**

Date: **August 12, 2003**
Cust. No. **1000043749**
Reported To: **Jerry Hintze**
Dean Wood
Scott Fullmer

Sludge: Improve Thickener Overflow Quality Meeting to Determine a Plan of Action

Hello Jerry, Dean, and Scott,

Today, we met to discuss the ongoing problem with solids carryover from the Thickeners. We have identified a number of factors that contributes to the current operating problems. Two of these factors include:

- 1) Incomplete oxidation of Sulfur to CaSO_4
- 2) Elevated Total Dissolved Solids

In an effort to reduce solids carryover, we have developed the following plan. We have learned a lot about the Sludge System during the past two years, yet lack daily operating data. As part of the effort to further understand the dynamics of the system, we propose recording daily operating data.

- 1) **Sludge Log** – I will develop a log and we will mutually agree on the format. We will track daily operating parameters.
- 2) **Dissolved Solids** – The TDS levels of the Scrubber System has increased to 42,000 mMHos again. We know that the high TDS makes it very difficult settle suspended solids and to obtain increased densities. We recommend adding water to the Recovered Water Basin and dropping the Sp. Cond. to <30,000 mMHos.
- 3) Modify the inlet piping
- 3) **Phase 1** – One thing being observed at this time is that some of the modules are seeing better oxidation than others. It would appear that the Liquid to Gas Raio is favors certain modules. Slurry samples taken from Unit #2 C Module has a 25-35% large solids break vs. the lighter smaller particles. The total suspended solids settle much quicker. The question has been raised, is it possible to operate two modules with air to facilitate more complete oxidation in thoses modules, which would then improve the total charactieristics of the solids going to the Thickeners? This appears to be a possilbilty, however this can't be done if the scale potential of the modules without air is increased. So, is it possible to operate in this manner and if so, how do we evaluate the scale potential.
- 4) **Phase 2** – If the above scerio is not successful, we suggest examining the operation of Thickeners in series.

Last night I visited Sludge and worked with Scott Robison and his crew. An interesting thing occurred in Sludge during the past couple of weeks. They were seeing a constant low density in the Thickener sludge, were not settling solids and not making good filter cake. This condition could possibly be associated with the thickener high recirc rates and high solids retention time. Because they saw no progress in improving the densities, they decided to shut off the polymer to the Thickeners. After the polymer was shut off for a short period of time, they saw an increase in density and the overflow cleared for several days.

IP12_000594

As I have considered this, I have decided this could suggest that the Thickeners, through high rates of recirc and continued feed of poly, had accumulated 'excess charge density'. Meaning, the smaller sheared polymer components were actually repelling each other because all charge sites were populated with similar charges. That is the only thing that seems to make any sense to me. Similar charges would repel each other and reduce density; dissimilar charges attract. As new uncharged particles are then introduced to the thickener, they react with the highly charged particles, agglomeration occurs, settling occurs, densities increase, filter cake production improves, and the world becomes a better place to live.

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This is my suggestion, what do you think? I'll talk with you next week.

Have a great 4th of July.



GE Betz

A Division of GE Specialty Materials

Customer: IPSC
Address: Delta, Utah
System: Boiler Feedwater System –
A) Summary of Jim Robinson Visit
B) Summary of Plan of Action

Date: August 12, 2003
Cust. No. 1000043749
Reported To: Dean Wood
Scott Fullmer
CC: Jerry Hintze

Hello Dean and Scott,

We met on August 12th to discuss the current operation of the Thickeners at Sludge. The following Plan of Action was laid out. The focus of this meeting is to evaluate what can be done to reduce solids carryover to the Recovered Water Basin and to improve solids handling, thickening and filter cake operation.

- 1) **Sp. Cond.** – Reduce the Sp. Cond. of the Recovered Water Basin to 30,000mMhos. The current level of 42,000mMhos has proven extremely difficult to settle.
- 2) **Scrubber Operation** – Scott has observed that certain scrubber modules perform better than others. He has seen an advantage of operating two modules had as high oxygen as possible in improving large solids formation. He wanted to conduct a test with this operating protocol to see if it helps at the Thickeners. *The concern is whether operating the other modules with little or no air results in a greater potential for scaling in those modules.* This will need to be considered and evaluated before we can produce with this test.
- 3) **Series operation of the Thickeners** – We have proposed this as a possible means to improve solids removal and flocculation. Before we do this, we need some things done.
 - a) Liquid entry to the Thickener Center Well needs to be tangential
 - b) Polymer feed needs to be initiated to the Center Well of the second Thickener
 - c) Operating Parameters need to be logged on a shift basis (pH, Sp. Cond., % SS, Turbidity, flow rates, and polymer feed rates.

This is my summary. Please review it.

Thanks,


Norm

IP12_000596

11/1/04 CD

MEMORANDUM

INTERMOUNTAIN POWER SERVICE CORPORATION

TO: George W. Cross Page 1 of 2
FROM: Dennis K. Killian 
DATE: October 27, 2004
SUBJECT: Recommendation to Perform Scrubber Thickener Sludge Test

Attached is a recommended test plan optimizing thickener operation. Please authorize the attached plan by signing below and returning this memo to Engineering.

We recommend that we conduct a test to optimize the operation of the Scrubber Thickeners. We expect this to take approximately one week of operation. Three changes in the current system will be necessary before the test can start:

1. Minor piping changes to introduce feed tangentially into the centerwell (see Figure I).
2. Stop recirculation within thickeners.
3. Install a temporary line from the underflow of A- and B-Thickeners to the centerwell of C-Thickener (see Figure II.)

We would not expect this to affect any other systems, except to potentially improve water quality to the Wastewater Holding Basin and possibly improve filtration.

As you are aware, there are two important functions we depend upon in the thickeners:

1. Thicken solids to allow effective filtration by the Drum Filters.
2. Clarify the overflow, minimizing solids going to the Wastewater Holding Basin and Evaporation Ponds.

At times in the past, the underflow solids have been too low which has caused filtration problems. This situation has improved, probably due to bigger crystals created by forced oxidation. However, overflow clarity continues to be a very real problem. Last year we paid \$400,000 to have a small portion of the Wastewater Holding Basin dredged of solids that should have

IP12_000597

been removed by the thickeners. The problem is serious enough that we have already lost all the ground we had gained by dredging.

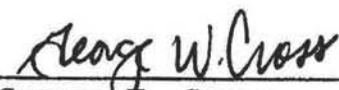
We have received recommendations from several sources on how to improve thickener operation, but our standard answer has been that we wanted to wait until Forced Oxidation was running to see if that solved the other problems. Forced Oxidation is now operating, and we still have most of the problems.

We know that thickeners have some structural weaknesses due to corrosion from the outside. We have discussed several options:

1. Excavate and repair or replace the existing thickeners.
2. Replace with hydrocyclones.
3. Replace with hydroseparators.
4. Replace with high-rate thickener.
5. Create a hybrid system combining two of the above.

We feel that it would be worthwhile to optimize operation of the equipment we now have, define the operating parameters necessary, and determine what it takes to operate it effectively. We then can evaluate the overall value of the thickener technology and know what capacity we can have in our normal operating range and what we can count on.

We will then have a good basis to compare with other technologies to determine how each will allow us to achieve our goals; optimize solids removal from the water to be evaporated, and effectively remove moisture from the cake so we can either dispose of it in the landfill, or sell it.



George W. Cross
President and Chief Operations Officer

SFJ/JKH:jmj
Attachments

Sludge Thickener Modifications

1. Install tangential feed in both thickener centerwells (see Figure I.)
2. Turn off solids recycle.
3. Install temporary piping from A-/B-Thickener underflows to C-Thickener centerwell.

Test Procedure

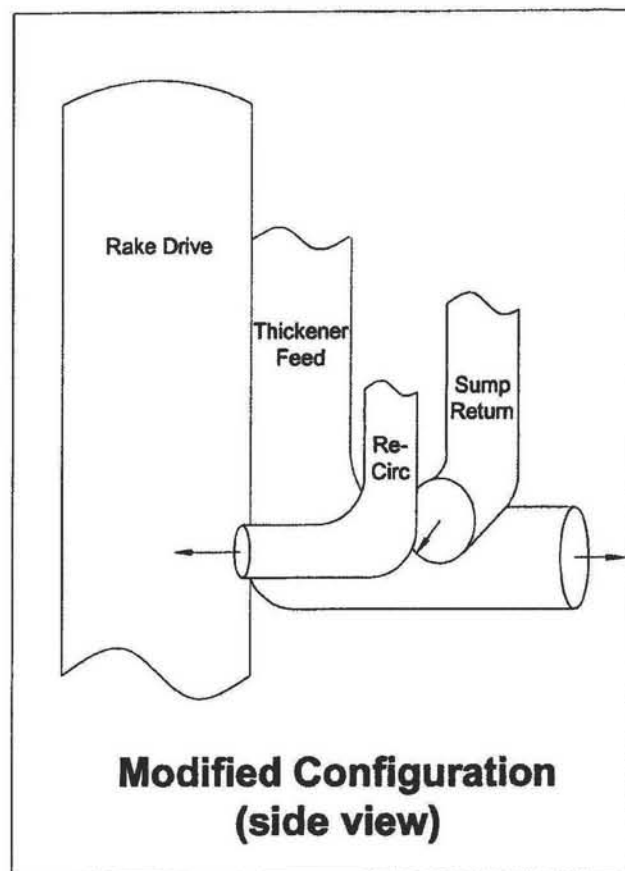
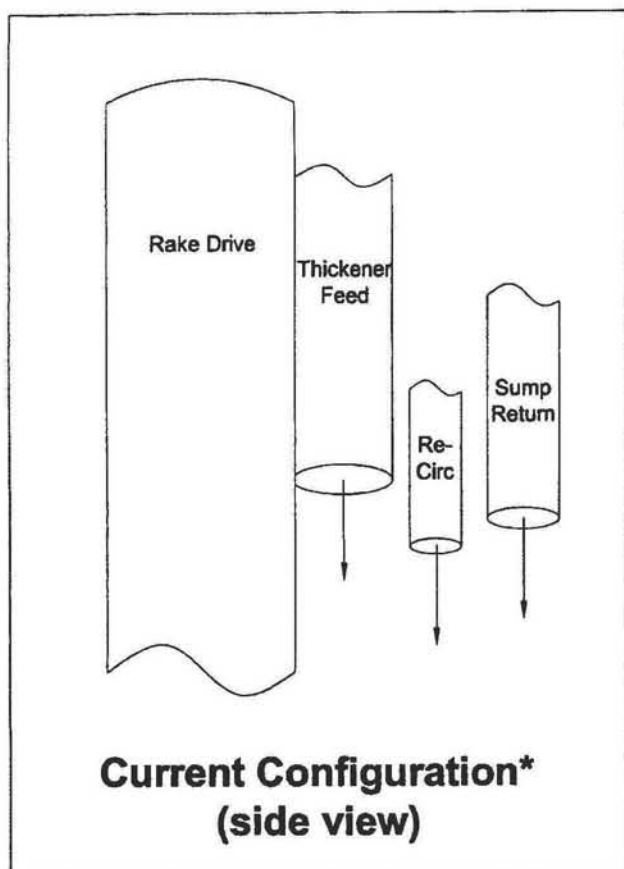
1. Continuously pump A- & B-Thickener underflows to C-Thickener centerwell at maximum rate.
2. Add water to the C-Thickener feed at ~1:1 ratio (180 gpm).
3. Allow solids level to build until underflow solids reach ~50 percent.
4. Draw solids off (*continuously*) through C-Thickener underflow. This will be a lower rate than we currently pump.
5. Adjust C-Thickener underflow pumping rate as needed to maintain 46-54 percent solids.
6. If solids concentration falls below the recommended range, pump polymer as filter aid to achieve desired solids in cake.

Reasoning and Objective for Test

1. Tangential feed to the centerwell. This initiates settling much closer to the top of the centerwell rather than stirring things up much further down (and out). The result is a larger settling zone and more effective thickening/clarifying.
2. Stop recycle to minimize shearing of the polymer. A polymer molecule is very long as molecules go. Every time it goes through a pump and even with smaller energy transfer, the polymer is broken into smaller pieces. Over time, with many recirculations, this can result in many short, highly charged molecules that no longer have the length to 'gather' the solids particles, become heavy and settle out. The result may be that there are many charged particles with no real gathering/settling action. Worst case, they may charge things up and actually cause repulsive forces.

3. Keep solids level in A-/B-Thickeners as low as possible by pumping underflow at full rate to the C-Thickener. The purpose here is to clear the somewhat-concentrated solids out of the A-/B-Thickener (which is now acting as a clarifier) as quickly as they settle to make room for more, reduce up-flow rate and minimize the overall solids inventory in the unit. By lowering the main liquid/solids interface very close to the bottom there is much less hindered settling and the solids have a much greater chance to settle, although they are not very concentrated or well-thickened by previous standards.
4. Feed dilution water to the C-Thickener feed. This may seem as though it would be opposite of what we want to do. In reality, there are two ways this is likely to help us. It will reduce the conductivity of the sludge by diluting it. The polymer works more effectively at lower TDS. In addition, a more dilute feed will allow the solids to separate more quickly when they first go into the centerwell. They will settle better in spite of the additional water volume. For purposes of the test, we will use fire water. Longer-term, we would use Ash Water or some other suitable source.
5. Feed filter-aid polymer if the solids level in the C-Thickener underflow drops significantly below 50 percent. This ensures effective operation of the filters if solids drop.
6. If filter feed solids exceed 50 percent stop feeding-filter aid polymer. If we are achieving good filtration, reduce or eliminate filter-aid polymer feed.

Figure I: Tangential Feed Modifications to the Sludge Thickeners



*Some of the current piping just ends, either vertically or horizontally.

The modified configuration would include elbows (already on some piping) and extensions (not on any piping).

The intent of this modification is to discharge thickener feed at the surface, in a tangential direction, such that all feed discharges horizontally and in the same direction as centerwell flow.

Extensions (beyond elbow):

Recirculation line = 10"

Sump return = 15"

Thickener feed = 18"

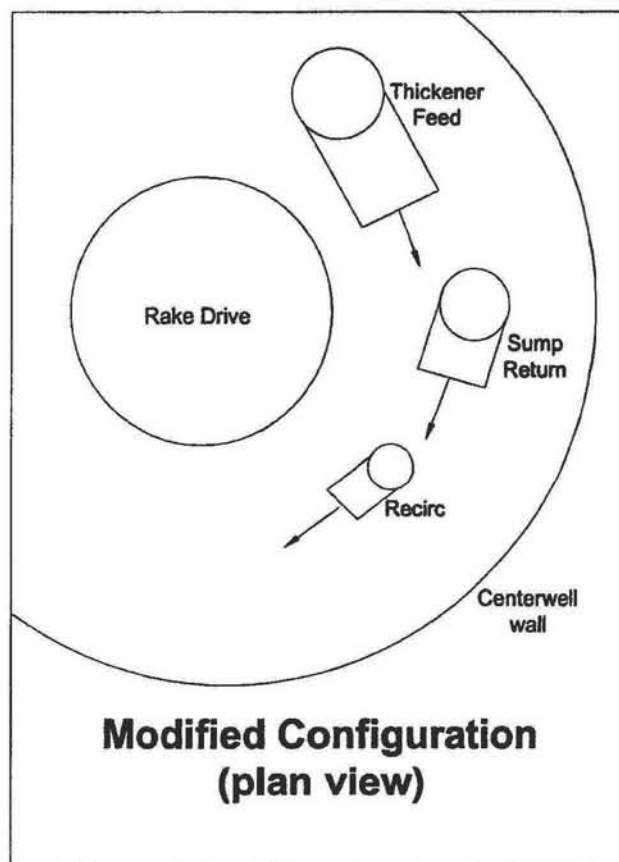
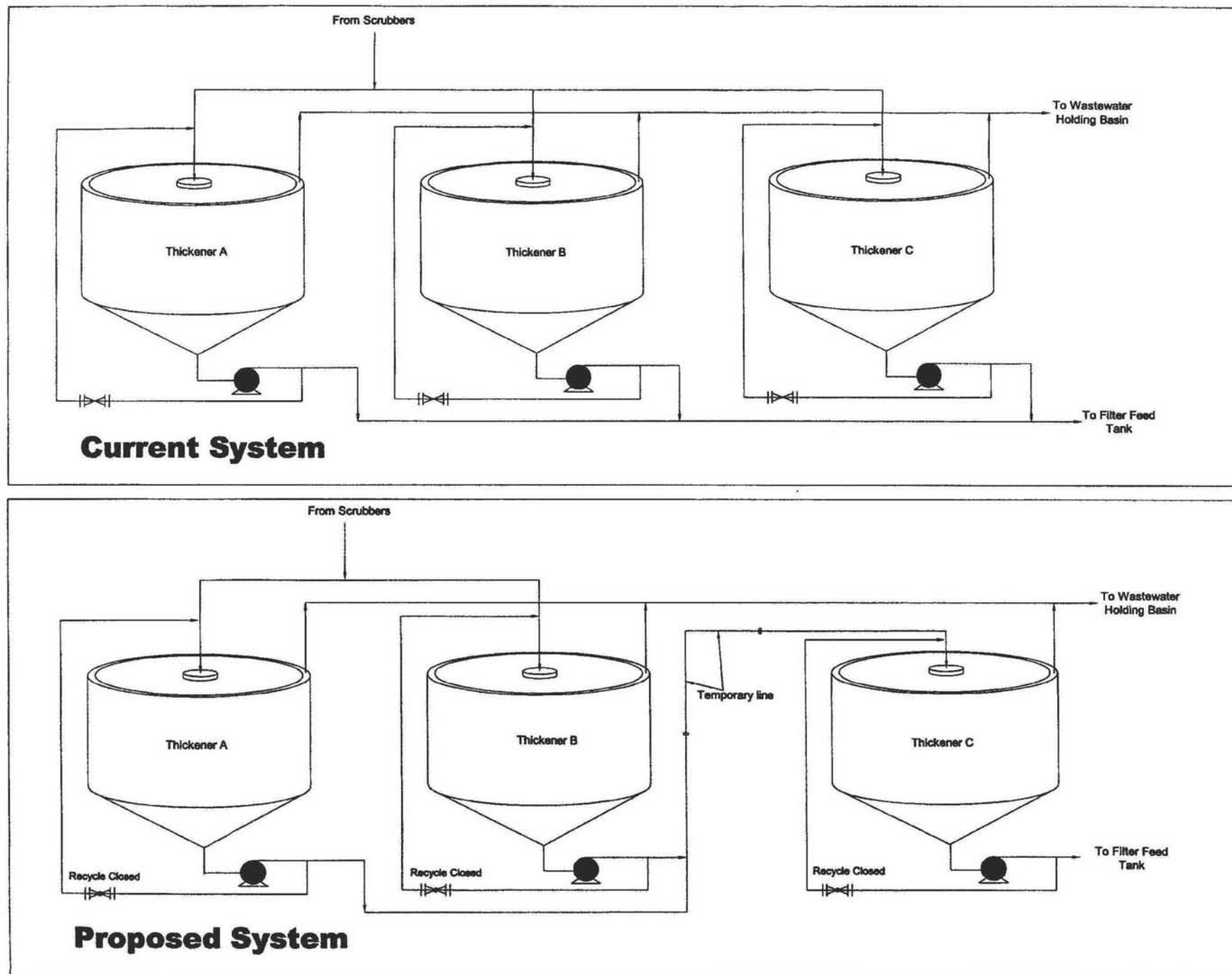


Figure II: Flow Modifications for Sludge Thickening Test



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Delta, Utah

Sludge System Thickeners In Series Evaluation

February 3, 2005

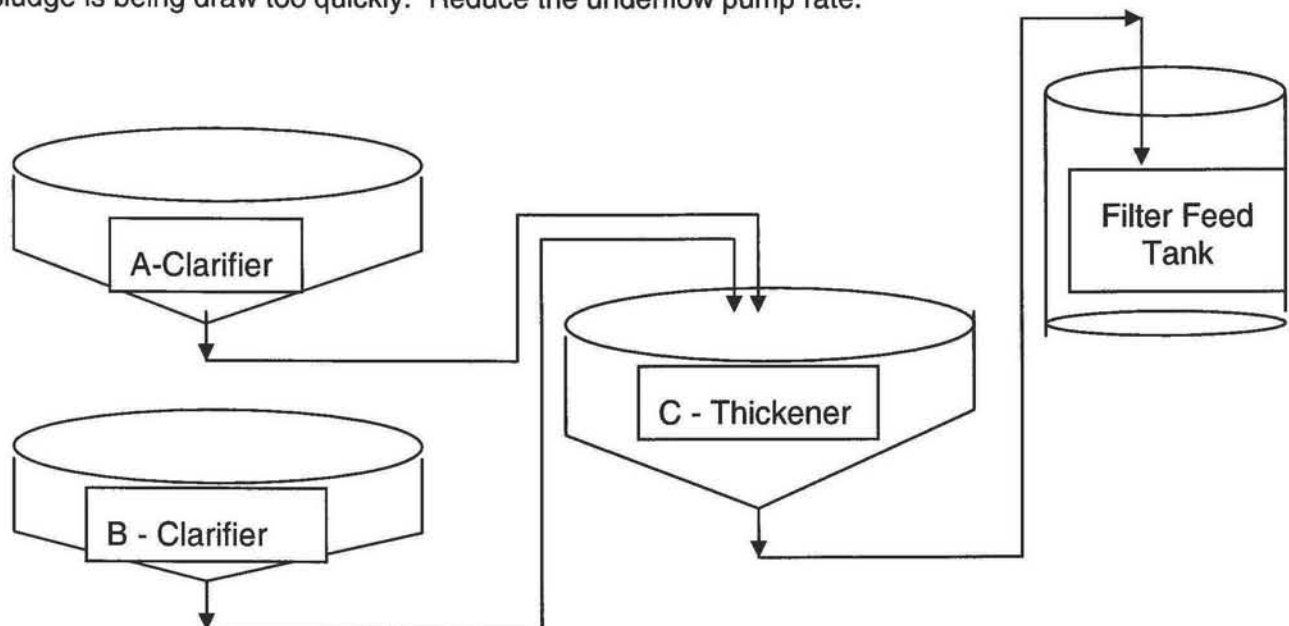
Background: Solids carryover from the Thickeners to the Recycle Pond has occurred fairly consistently for four years. Changes in the Scrubber have helped produce a higher ratio of larger CaSO_4 particles vs. smaller CaSO_3 particles, however there are still plenty of small particles that carryover. We see a benefit of eliminating internal recirculation of sludge and have discussed and reviewed the approach. Recirculation of sludge damages the flocked particles.

Goal: Our goal is two fold:

- 1) To produce clear water overflow
- 2) To thicken Solids that can produce good filter cake.

Economic Benefit: The economic benefit is cost avoidance. We need to stop sending solids to the Recycle Pond, which have to be dredged from the Pond at a later time.

Thickeners In Series – Please refer to the initial Thickeners as **Clarifiers**. Their underflows constantly flow to the C-Thickener. The only flow to C-Thickener is the underflow from A & B Clarifiers. Adjust the rate of underflow based on 3-4 feet clear water measured by a Sludge Judge. Use the Sludge Judge and measure each unit every 4-hours. If the clear water is greater than 4', sludge is being draw too quickly. Reduce the underflow pump rate.



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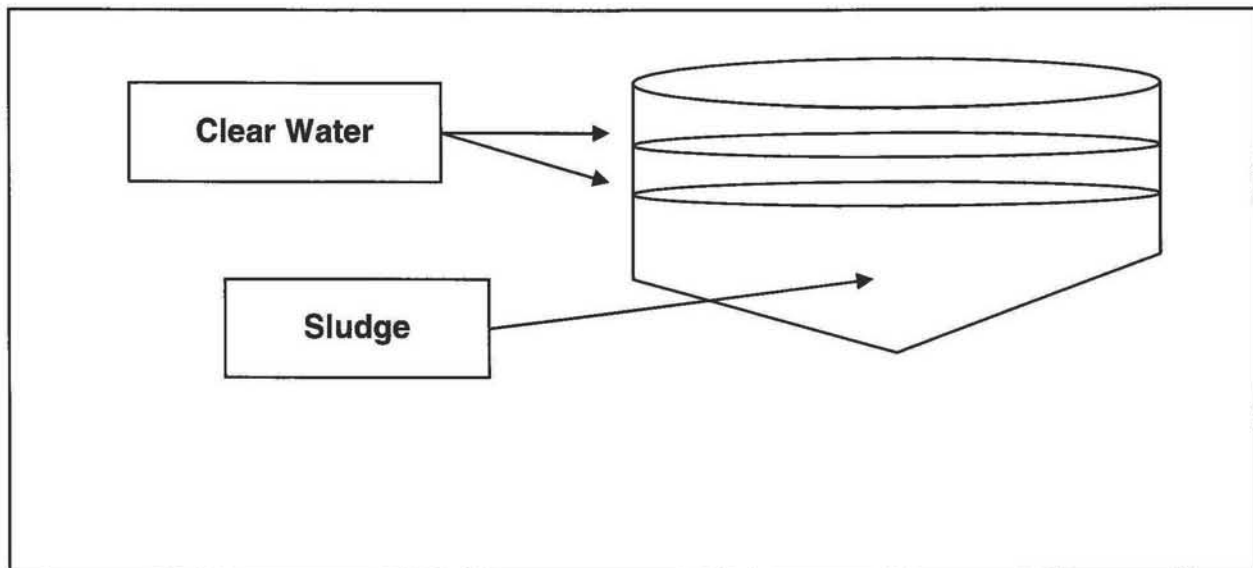
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Delta, Utah

Sludge System Thickeners In Series Evaluation

Theory of Thickeners In Series – The theory is to first 'Clarify' the solids. The Scrubber slurry flows to one or two Clarifiers (Thickeners) in parallel. We add 1-3 ppm of AEC1703 to these streams. From this point on, we refer to these as Clarifiers. Then we constantly take the underflow from A & B-Clarifiers to the third Thickener (C-Thickener) and we add more AE1703, 3-6 ppm, to increase the density of the sludge. We take a constant underflow from C-Thickener to the Filter Feed Tank. Do these things to control & operate the Thickeners.

- 1) **Never recycle** sludge (it damages the particle size). Constantly flow from the underflows of A & B Clarifiers to the center well of C-Thickener.
- 2) **Measure and control sludge** bed thickness (3-4 feet)–use the Sludge Judge
 - **If Clear Water is less than 2'**, increase the underflow pump rate to lower the sludge bed.
 - **If Clear Water is greater than 5'**, we are removing sludge too quickly. Reduce the underflow pump rate.
- 3) **Adjust the Polyfloc AE1703** feed based on sludge density and clear water overflow. Keep C-Thickener flowing constantly. Adjust the flow rate based on clear water and sludge density. If you have greater than 4' of clear water, slow down the underflow pump. If density is less than 30%, increase the feed of AE1703.



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Delta, Utah

Sludge System Thickeners In Series Evaluation

Operator Actions: Please do the following:

- A) **Mix the AE1703 in the Mix Tank** – Typically, we mix 1.5 gallons of AE1703 to 300 gallons of water. Fill with water to the 1' above the propeller. Turn on the propeller and slowly add the 1.5 gallons of AE1703 to the vortex of the propeller. Then fill to the top of the tank and continue to mix for 60-minutes. Then shut off the agitator. We will be using 2-3 Tanks of poly per day.
- B) **Measure Polyfloc AE1703 Pump Rate** – This is done by shutting off all by one AE1703 pump, filling the 1,000 ml Graduated Cylinder with the 'made down AE1703' in the mix tank, shutting off the mix tank, opening the Calibration Cylinder valve, and timing the number of ml per 30-seconds drawdown.
- C) **Measure the Clear Water Height** twice per shift. Use the Sludge Judge to do this. The target for clear water is 3-4 feet. If it is more or less, either increase or decrease the underflow pump rates to bring it into control.
- D) **Carefully track the Torque Reading on the Rakes.** A 10-20% torque is probably okay, but if the torque rate is increasing (trending up), that is bad. Review the operation of the Thickener. The higher the Torque, the more stress there is on the Thickener Rake. Course of actions could include:
 - a. **Increase the underflow**
 - b. **Decrease the AE1703 feed to that Thickener**
 - c. **Raise the rake**

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Sludge System Thickeners In Series Evaluation

Date & Time

/ /

- Top off AE1703 Mix Tank** – 1.5 gal. Per 300 gal. Water
- Fill Tank** with water, turn on mixer, slowing add AE1703
- Check & refill Mix Tank** every 4-5 Hours

a) **Check & Record** Under Flow, Thickener Feed, Polymer

- Pick target rate (e.g. 1.5 ppm – mid range)
- Calculate** Polymer AE1703 Feed in mils per minute
- Adjust Polymer** AE1703 Feed to calculated value

Calculated Pol. Fd $\rightarrow 1.5 \times (660 \text{ gpm}) = 330 \text{ mils per minute polymer feed}$
Example: $\frac{\quad}{3}$

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June 23, 2005

INTERMOUNTAIN POWER SERVICE CORPORATION

850 W. Brush Wellman Road
Delta, Utah 84624-9546

Attention: Mr. Jerry Hintze
CC: Mr. Scott Johnson
Ms. Cindy Jones
Mr. Dean Wood

RE: SLUDGE FILTER STUDY (6/23)
STUDY & REPORT PREPARED BY: SCOTT JOHNSON
NORM HESS

Dear Jerry,

Today, Scott Johnson, Carl Greenhall, Dan Nielson, and I worked on the Sludge Filters. The focus of our work was to identify optimal operating parameters. This includes the physical operation of the Filter and the application of a filter aid. These are our findings.

Summary:

- 1) Repair and Maintenance** - The Drum Filter needs several repairs and maintenance to be fully functional. Filter cake production is significantly adversely affected by its current condition.
- 2) Filter Aid** - Filter Cake Tonnage increased with Polymer AE1703 increased feed, *however* Vat Level variability makes it difficult to determine an optimal feed rate. A second test needs to be administered with constant Vat Level Control. Sludge level in Filter Vat should be 37.5% per design.

Repair and Maintenance

Drum Filters - The following Filter components are adversely affecting the performance of the Drum Filters. We will prioritize them in the order of importance.

- 1) **Automatic Filter Valve and the valve wear plate** - In the Operations Manual, it refers to the Automatic Filter Valve and the valve wear plate as the '*heart of the system*'. In other words, if it isn't working right, nothing will work right. The designed vacuum for the 'Forming Section or Pickup Section' is 21 in. of Hg. Currently, the vacuum of the Forming Section is fluctuating between 10 to 17 in. of Hg. This difference between design and operating vacuum is huge and will compromise filter performance. Also, the 'Drying Section' is designed to operate at 5 in. of Hg and it was fluctuating between 0 to 1 in. of Hg. Adequate and consistent vacuum is crucial for filter performance. The Automatic Filter Valve and Valve Wear Plate need to be repaired and set up as a PM item, in order to consistently maintain vacuum performance.
- 2) **3-Bad Filter Sections** - As we observed the filter, it became obvious that three sections were not picking up solids. This is compromising vacuum in these sections and cake production by as much as 20-25%. It is difficult to determine the cause, but it could be

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pluggage of the vacuum piping, double layering of filter cloth, etc. A direct inspection is needed to determine the cause.

- 3) **Rips in Filter Cloth** – There are several tears (seven or more) in the filter cloth, which compromise vacuum and performance. Any tear in the filter cloth needs to be repaired immediately.
- 4) **No speed control of the drum** – One control parameter, which is *unavailable* to the Operators, is the speed control of the drum. This is important because there is sludge density variability. This needs to be repaired so the Operator has the option to adjust the speed to obtain optimal filter cake production.
- 5) **Back up Filter** – The C Filter is the only backup for the A Filter, however there are problems with the C Filter. Apparently the bands have been set too close together so the filter cloth does not adequately flex to effectively release the cake. Thus, it is limited on how well it can perform. We suggest that both Filters be inspected, cleaned, repaired, and re-clothed for optimal performance.
- 6) **'Flex' Air Pressure too high?** – The air pressure is significantly above the original design. We may need more than design or perhaps we need to wire-wrap a little more openly to allow the cloth to flex more. With the higher pressure, we are probably causing the cloth to wear prematurely.
- 7) **Long-term Crew** – I know this thought is somewhat '*out of the box*', however we suggest that a 6-12 month crew assignment be made in Sludge. Both the filters and the thickeners have a certain amount of 'art' to their operation. Having the same group operating this equipment for a longer period of time could have significant advantages in learning equipment operation and how to react under various circumstances. This crew would work with Engineering, Maintenance, and GE W&PT to identify, modify, and repair the deficiencies of the system. This would be the least expensive way to improve the system because:
 - you would develop a higher level of expertise
 - the Team (Eng., Main., and GE W&PT) could identify the '*vital few*', truly important things to correct
 - the collective effort would be better focused and be able to establish long-term practices to improve operations.

Filter Aid -

We are using Polymer AE1703 for the filter aid. This is also the flocculant being used in the Sludge Thickeners. In the past, when the Sp. Conductivity of the Thickener Feed Water exceeded 40,000 mMHos, the system was essentially non-functional with solids going over the weirs. With the new operating practices, which includes 'no recirc' of Thickener solids, but rather constant underflow to the Filter Feed Tank, the Thickeners are now producing clear water in the Thickener Overflow, even with a Sp. Conductivity of 48,000 mMHos. Thus, we are very encouraged that the right flocculant is in use, however we are going to conduct polymer screenings to validate that. We will look at the Thickeners as well as the Filter Aid.

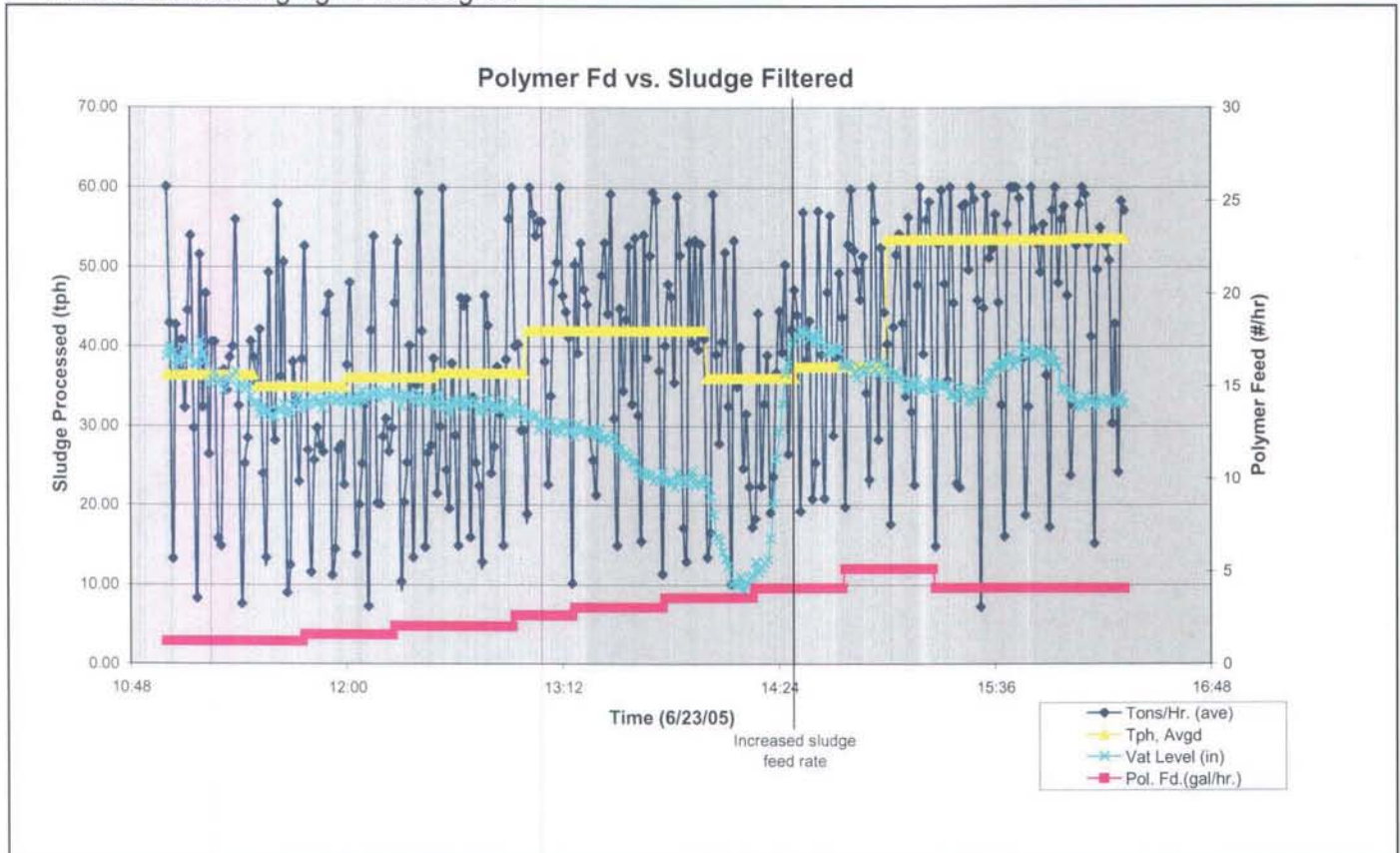
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Scott has developed the following Chart with the use of Pi and data we collected. It is interesting to note the Filter Vat variability. At the time of the Study last week, we failed to initially realize that the Vat level was changing to this degree.



Notice an increase in Filter Cake tonnage at 1430 and then compare it to 1048, which had a similar Filter Vat level. The Filtered Sludge increased from 36 tph (tons per hour) to 53 tph, is a 47% increase. Since the Filter Vat level declined from 1245 until 1400 hours, it is difficult to say during that time, whether an increase feed of AE1703 actually increased Filtered Sludge production.

In the next Study, we will track the following parameters:

Time	Hz	Filtered Sludge (tph)	Slurry (gpm)	AE1703 (gph)	Water (gph)	Density (filter feed)	Filter Vat Level
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In the next Study, we will work at maintaining the Filter Vat Level consistently. This is our Report. I look forward to discussing it with you.

Sincerely,

Norm Hess
GE Water & Process Technologies

Scott Johnson
Intermountain Power Service Corporation

GE Betz

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July 7, 2005

INTERMOUNTAIN POWER SERVICE CORPORATION

850 W. Brush Wellman Road
Delta, Utah 84624-9546

Attention: Mr. Jerry Hintze
CC: Mr. Scott Johnson
Ms. Cindy Jones
Mr. Dean Wood

**RE: REVIEW OF FILTER MECHANICAL
FILTER AID CONCENTRATION**

**STUDY & REPORT PREPARED BY: SCOTT JOHNSON
NORM HESS
RICH WALLACE**

Dear Jerry,

Today, Rich Wallace, Scott Johnson, and I reviewed the Filter Mechanic's. This is a perfect example of the 80/20 Rule. The mechanical performance of the Filter accounts for 80% of its ability to be successful and the Filter Aid contributes 20%. So we are focusing on two critical operating parameters: mechanical capability & filter aid.

Mechanical Capability – Last week we identified several area's that need repair or PM work. They include:

- 1) **Automatic Filter Valve and the valve wear plate** –Repair or replace.
- 2) **3-Bad Filter Sections** – Inspect, repair seals/seats/pipes, and clean out all lines.
- 3) **Rips in Filter Cloth** – Replace filter cloth and/or repair tears.
- 4) **Drum speed control** – Repair & activate drum speed control.
- 5) **Back up Filter** – Have two fully functional filters
- 6) **'Flex' Air Pressure too high?** – Meet specification only – higher pressure damages the filter cloth

The 3-sections of non-functional filter, has turned into 5-sections. This strongly suggests the issue is pluggage of the associated piping. Please make sure to inspect the associated piping and flush it. Please make sure that all sections meet 'new filter specifications'. It truly is important.

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Filter Aid – We screened AE1703 for feed concentration to the filter. The thing that we're looking for was the point that the polymer curdles the sludge. We tested 30 ppm, 60 ppm, 90 ppm, 120 ppm, 150 ppm, and 180 ppm. The curdling occurred with all concentrations and progressively increased with increasing concentration. The ideal points vs. cost effectiveness were in the 30-90 ppm.

Test	AE1703	Comments - Curdling 0 (none) to 5 (maximum)
1	30 ppm	2 – light curdling
2	60-ppm	3 – moderate
3	90-ppm	4 – moderate
4	120-ppm	5 – maximum
5	150-ppm	5 – maximum
6	180-ppm	5 – maximum

On our next visit we will re-screen polymers to verify the best choice. We are getting good Thickener performance, with clear water overflow, even at 50,000 mMhos. However, it is time to re-screen and re-test.

Best Regards,

Norm Hess
GE Water & Process Technologies

Scott Johnson
Intermountain Power Service Corporation

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